

Abstract

A lead-free joining material includes zinc and tin as major components, and at least any one of bismuth and germanium as an additive element. The joining material includes a core part, and a surface layer covering the core part. The surface layer
5 includes a solid-solution phase which contains the tin as a main component and a needle crystal which is dispersed in the solid-solution phase and contains the zinc as a main component. Moreover, a concentration of the additive in the solid-solution phase is higher than a concentration of the additive element in the core part, and the concentration of the additive element in the solid-solution phase is in a range of 0.6 to
10 4.0 % by weight.